CAUSAL MODEL FOR MANAGEMENT OF SUBCONTRACTORS IN WASTE MINIMIZATION

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SUMMARY

The level of construction and demolition waste generation is an important indicator of the environmental acceptability of a construction activity. The use of excessive construction materials constitutes a negative impact on the environment and the disposal of that construction and demolition waste causes further problems. Such construction and demolition waste is composed of potentially valuable materials. Thus, there is an urgent need to reduce the amount of such waste. In order to solve the problem of high wastage levels in the Singapore construction industry, it is important that contractors adopt steps to minimize the production of construction and demolition waste as a vital part of their construction programs.

This study aims to develop specific waste minimization strategies for main contractors to curb the waste problem caused by subcontractors. The scope of the study is limited to the larger general building and civil engineering contractors, and trade subcontractors. Literature review was done on the waste minimization issues and this was followed by model construction.

This study has introduced the application of causality to the problem of waste generation among contractors in the Singapore construction industry. A causal model is developed to explain the dynamic construction waste generation behaviour exhibited by contractors on site. The model shows that several fundamental factors, ranging from the wasteful practice of subcontractors, lack of integration and coordination of team players,

inefficient usage of construction materials by subcontractors, to incidence of rework, are the main causes of waste generation on site.

Based on causal methodology, the Construction Waste Minimization model was constructed using Supply Chain Management and Management Control concepts. From these concepts, eight main strategies and other methods for main contractors to manage subcontractors in waste minimization were identified.

The model was tested in two ways. Firstly, a postal questionnaire survey of contractors and subcontractors in Singapore was undertaken to check the validity of the variables in the model. The survey results were used to test the validity of the construction waste minimization methods obtained from the literature review and used in the model construction. Secondly, three in-depth case studies were conducted to confirm the causal loops in the model. The findings from the case studies generally support the model and are consistent with those from the survey. The survey results and case study findings confirm that the model is valid and the case studies corroborate the model's practical application.

It is recommended that both main contractors and subcontractors in the construction industry adopt the Construction Waste Minimization model which is developed and tested in this study to reduce construction waste in their future projects.

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List of Abbreviations

BCA -	Building and Construction Authority, Singapore
BRE -	Building Research Establishment, UK
BREEAM -	Building Research Establishment Environmental Assessment Method
BWAS -	Building Waste Assessment model
CIB -	International Council for Research and Innovation in Building and Construction
CIDB -	Construction Industry Development Board, Singapore
CIOB -	Chartered Institute of Building, UK
CIRIA -	Construction Industry Research and Information Association, UK
CONQUAS -	Construction Quality Assessment System
CWM -	Construction Waste Minimization
CWMM-	Construction Waste Minimization model
CD -	Construction and Demolition
DB -	Design-and-Build
EA -	Environmental Auditing
EIA -	Environment Impact Assessment
EMS -	Environmental Management System
ENV -	Ministry of Environment, Singapore
FFM -	Flexible Firm model
HDB -	Housing and Development Board, Singapore
JIT -	Just-in-Time
LTA -	Land Transport Authority, Singapore
MIT -	Massachusetts Institute of Technology, UK
MND -	Ministry of National Development, Singapore
MOL -	Ministry of Labour, Singapore
MOM -	Ministry of Manpower, Singapore
NEA -	National Environment Agency, Singapore
NTU -	Nanyang Technological University, Singapore
NUS -	National University of Singapore, Singapore
SCM -	Supply Chain Management
SCAL-	Singapore Contractors Association Limited
SEPA -	Scottish Environmental Protection Agency
SLOT-	Singapore List of Trade Subcontractors
SM-	Scientific Management
SPSS -	Statistical Package for Social Sciences
TQM -	Total Quality Management
UK -	United Kingdom
UKEPA -	Environmental Protection Agency, UK
US -	United States
USEPA -	Environmental Protection Agency, US
WM-	Waste Minimization
WMP -	Waste Management Plan